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(54) IMPROVEMENTS IN AND RELATING TO REFRIGERATED FOOD STORAGE CABINETS

(71) We, LEC REFRIGERATION LIMITED, Shripney Road, Bognor Regis, Sussex, PO22 9NQ, a British Company and ERNEST ANREW COWEN, a British subject of the Company's address, Shripney Road, Bornor Regis, Sussex, PO22 9NQ, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to refrigerated food storage cabinets such as are used, for instance, in retail shops and stores for the retention of refrigerated foodstuffs, which are sometimes known as deep freeze frozen foods, on display prior to their being sold to the general public. Such cabinets may also be used for the bulk storage of refrigerated foods in canteens, large kitchens (e.g. in hospitals, factories, hotels) and in any other location where such bulk storage is required.

Refrigerated food storage cabinets of the kind to which this invention relates are customarily in the form of open-top rectangular boxes or shells approximately 5 to 6 feet long, 2 to 3 feet wide and 2 to 3 feet high standing on a ventilated box pedestal or plinth, of double wall and base construction, the inner shell forming a food storage chamber with thermal insulation in the interspace approximately 2 to 4 inches thick, and with cooling means along the whole length of the food storage chamber on each long side both at the level of the top of the food storage chamber (the upper cooling means) and from the bottom of the food storage chamber to approximately two-thirds-way up (the lower cooling means). A source of refrigeration is situated inside the box pedestal or plinth together with ancillary apparatus, for instance, motor-compressor, fan and condenser, which is appropriately connected by piping to the upper and lower cooling means in the cabinet.

Customarily hitherto the lower cooling means in the form, for instance, of a serpentine of pipes or coils (sometimes known as an evaporator) has been set in contact with the walls of the inner shell of the cabinet in the interspace which carries the thermal insulation, while the upper cooling means has evaporators approximately 4 inches wide and 4 to 6 inches deep situated along the longer upper inner edges and projecting inside the food storage chamber.

The upper cooling means customarily has a defrosting mechanism and corresponding drip tray with appropriate drainage for water. Metal covering pieces usually form a protective trim for edges, sides and corners. Covers for closing the top opening during standby periods (e.g. overnight or at week-ends) may also be provided.

The objective in such constructions is to maintain a temperature of not more than −18° Centigrade at the level joining the lower edges of the upper evaporators—that is, at a level approximately 4 to 6 inches below the top of the food storage chamber —with lower temperatures towards the base of the food storage chamber.

Several problems arise from the customary construction. The most important of these concerns failure to achieve a horizontal level of temperature for the −18°C. isothermal across the food storage chamber. Adjacent the upper evaporators, that is, near the long sides of the food storage chamber, a satisfactory cooling is attained, but nearer the centre line ambient air at normal room temperatures, and these in some instances may be of the order of 15 to 20°C. by reason of the requirements of the Shops Act) has increasing access, with the result that the −18°C. isothermal takes on an appreciable dip transversely with a maximum sag along the central line of the food storage chamber end to end (parallel with the upper evaporators). The sectional isothermal contour may be linked to the curve of the surface of a liquid whirling axially in a cylinder, or an inverted Normal (Gaussian) Distribution curve in statistical theory. The effect is that food-

stuffs along the centre of the food storage chamber at the levels corresponding with the upper evaporators are not kept at or below −18°C. even though the evaporators may be over-run (that is, operated to yield much lower temperatures than would otherwise be required). Hence the effective cooled storage space of the cabinet may well be considerably less than the physical dimensions would indicate, and loading to full capacity may result in spoilage of the upper layers of foodstuffs.

Another problem is concerned with maintenance, repair or replacement of the lower evaporators. When these are in the interspace occupied also by the thermal insulation, appreciable trouble and expense is likely to be encountered in gaining access to them, for, in essence, the whole structure must be dismantled and re-built. Further, if the thermal insulation is of the preferable *in situ* foamed type, complete replacement of the cabinet walls and insulation will be required.

Principal objectives of the present invention are to simplify and cheapen construction and maintenance, to render cooling more effective, and so to design and position the upper cooling means that the contour of the −18°C. isothermal is substantially flat and not bowed downwards, thus enabling a maximum use of storage space to be achieved. Another objective is the provision of a symmetrically-cooled food storage chamber with improved visibility of, and access to, the contents from any position, especially if an island site installation is desired, that is, a site with access to all sides of the cabinet.

A further objective is to avoid the need for replacement of the thermal insulation or cabinet structure during maintenance operations.

According to the invention a refrigerated food storage cabinet comprises an open-top double-shelled cabinet of rectangular box-like form, the inner shell of which provides a refrigerated food storage chamber, with thermal insulation in the interspace between the walls and the bases of the respective shells, the said double-shelled cabinet standing on a box pedestal or plinth open at the sides to form a ventilated housing for a cooling fan and two independent motor-compressor refrigeration units each with an associated condenser and connecting piping, one of the said motor-compressor refrigeration units and condensers being connected to a lower cooling means situated in spaced relationship inside and parallel to the lower parts of the walls above the base of the said food storage chamber, and the remaining one of the said motor-compressor refrigeration units and condensers being connected to at least two upper cooling means situated across the top of the said food storage chamber at right angles to the long side walls of the cabinet and parallel to one another approximately equidistant from the end walls of the food storage chamber and to each other, and a metal trim closing the top of the interspace between the said two shells of the cabinet and adapted to support the said upper cooling means and to support individual covers resting between the inner edges of the said metal trim and the appropriate edges of the said upper cooling means.

The invention is also concerned with lower cooling means, readily-detachable and demountable, for a refrigerated food storage cabinet which comprises a combination of vertical plates and panels of finned tubes in banks of serpentine form fed by refrigerant and situated between the lower parts of the walls of the food storage chamber, these vertical plates and finned tubes being situated parallel to the walls of the food storage chamber all round and having a gap between their bottom edges and the base of the food storage chamber, whereby a vertical channel open along its base is formed adjacent each wall of the food storage chamber to allow free circulation of air over the cooling units into the food storage chamber of the cabinet.

The invention also comprises upper cooling means for a refrigerated food storage cabinet, these cooling means comprising at least two units situated across the top of the cabinet at right angles to the long side walls and parallel to one another, each unit consisting of one or more readily-detachable and demountable banks of finned tubes of serpentine form through which refrigerant can circulate, the said fins having a tapering vertical section of substantially inverted isoceles triangular or inverted symmetrical trapezium shape with side edges preferably curved concavely to form convenient guides for cooled air into the food storage chamber while still serving to conduct condensate during defrosting periods to an appropriately situated drip tray and drainage system.

The accompanying drawings illustrate by way of example one proposed method of carrying out the invention in which

Fig. 1 is a diagrammatic sectional elevation of a cabinet, and

Fig. 2 is a vertical section along line A—A of Fig. 1.

An inner shell 1, which ultimately forms a food storage chamber and an outer shell 2 are separated by an interspace 3 filled with thermal insulating material, preferably of the expanded polyurethane type which can be foamed *in situ*. The combined shells stand on a hollow plinth or pedestal 4 which has ventilation openings in its ends and sides. Inside pedestal 4 are situated two independent electric motor-compressor refrigeration units 5, each with its associated condenser and connecting piping all of known form and not further shown in detail leading

respectively one to the upper and the other to the lower cooling means. Pedestal 4 also houses an electric fan appropriately situated to cool the condensers, also of known form.

Inside shell 1 substantially vertical thin plates 6 are supported in spaced relationship parallel to the lower parts of the walls and above the base of shell 1 with banks of finned cooling tubes (evaporators) 7 spaced between them and the walls all round shell 1. Tubes 7 are connected by piping to one set of motor-compressor and condenser 5 to form a self-contained lower cooling and refrigeration system.

The top between shells 1 and 2 is closed and the lips of shells 1 and 2 are separated, by a metal protective trim 8 having an inwardly-projecting nosed edge 8a. From side to side at right angles to the long walls of the cabinet upper cooling units 9 are detachably and demountably supported with their tops approximately level with trim 8 and approximately equidistant from the ends of the food storage chamber and each other. Cooling units 9 comprise banks of finned tubes 10 of serpentine form through which refrigerant is circulated, the fins 11 in vertical section being of substantially inverted isosceles triangular or inverted symmetrical trapezium shape with side edges curved concavely. A drip tray 12 is carried under the fins with appropriate drainage connexion (not shown). The whole cooling unit is enclosed in a detachable perforated casing 13. Normally two cooling units 9 would be provided, but for longer lengths of cabinet or for more intensive cooling additional units may be used. In any case, these upper cooling units are connected by flexible piping to the other set of motor-compressor and condenser 5 to form a self-contained upper cooling and refrigeration system separate from that serving the lower cooling means. The upper cooling units carry defrosting means in known manner. Appropriate electrical connexion points, thermostats and associated control gear (not shown) are installed in known manner. For standby periods individual covers (not shown) may be carried upon the nosed edge 8a and the appropriate edges of upper cooling means 9, with or without hinges as desired, to close the various parts of the food storage chamber.

The design described lends itself readily to module or unitary construction in that the insulated cabinet can be of standardised dimensions with arrangements for anchoring in position complementary units comprising plates 6 and evaporators 7, and evaporators 9, with simple provision for the interconnecting pipework for motor-compressor systems 5 and the respective evaporators. This arrangement ipso facto renders the lower and upper cooling means readily accessible without the need for opening up interspace 3, and not only facilitates and cheapens maintenance work but is itself a simpler and less expensive construction than hitherto, enabling in particular the use of in situ foamed thermal insulation which can be allowed to set hard and so strengthen the permanent cabinet structure.

The vertical channels formed by plates 6 adjacent the lower parts of the sides of the inner shell afford free access of air which can readily pass downwards over the associated cooling evaporators 7 by natural convention. Cooled air is thus distributed more effectively throughout the lower interior of the food storage chamber.

Although plates 6 and 7 and evaporators 7 lie inside the cabinet, they occupy little space and the loss of food storage space is not great. The advantages accruing—greater efficiency in cooling, better accessibility—are considered far to outweigh this minor drawback.

The form of the upper cooling means here described is more compact and more effective than the customary evaporators along the upper long edges of the food storage chamber.

By the position the upper cooling means occupies it effectively neutralizes the downward dip in the isothermals, enabling a uniform level of cold to be attained across the food storage chamber. Also, visibility of the contents of the chamber is much improved when there is no cooling unit projecting inwards along the upper edge.

By suitably contouring the cross-section of evaporator 9 e.g. by curving the surfaces of the casing and the edges of the fins concavely, improved cooling air flow can be achieved. while drip tray 12 may be made relatively narrow, reliance being placed on surface tension to allow the curved surfaces to conduct liquid to the drip tray during defrosting.

The level of the bottom of evaporator 9 in relation to the tops of evaporators 7 may be made adjustable (e.g. by providing means for raising or lowering the unit 9 about a mean position) whereby the required isothermal contour over the top of the food storage chamber contents may be varied in different cases.

The provision of separate refrigeration systems for the lower and upper cooling means contributes to more efficient operation under running conditions, whereby differentials between the effects of each system may be controlled or reduced as required.

Accessibility to the contents of the cabinet from all sides is much improved in the absence of inwardly-projecting side evaporators at the top, so that the new arrangement is specially suitable for island site installation, that is, installation on a site allowing free access from all sides.

Covers for standby periods are smaller and more easily handled, and if required, can permit access to only part of the food storage space at a time, so conserving the cold atmosphere inside. Also, there is a greater visual display area for the stored foods, size for size, as compared with earlier designs having upper cooling means at each interior long upper edge of the food storage chamber.

With the design and method of construction above described fabricating costs are minimised by reason of the possibility of using module or unitary construction, maintenance operations are facilitated, technical performance as regards cooling the interior of the cabinet is improved, accessibility to, and visibility of, the food contents of the cabinet are bettered, and smaller covers can be provided which enable part of the contents only to be exposed at discretion.

WHAT WE CLAIM IS:—

1. A refrigerated food storage cabinet comprising an open-top double-shelled cabinet of rectangular box-like form, the inner shell of which provides a refrigerated food storage chamber, with thermal insulation in the interspace between the walls and the bases of the respective shells, the said double-shelled cabinet standing on a box pedestal or plinth open at the sides to form a ventilated housing for a cooling fan and two independent motor-compressor refrigeration units each with an associated condenser and connecting piping, one of the said motor-compressor refrigeration units and condensers being connected to a lower cooling means situated in spaced relationship inside and parallel to the lower parts of the walls of and above the base of the said food storage chamber, and the remaining one of the said motor-compressor refrigeration units and condensers being connected to at least two upper cooling means situated across the top of the said food storage chamber at right angles to the long side walls of the cabinet and parallel to one another approximately equidistant from the end walls of the food storage chamber and to each other, and a metal trim closing the top of the interspace between the said two shells of the cabinet and adapted to support the said upper cooling means and to support individual covers, resting between the inner edges of the said metal trim and the appropriate edges of the said upper cooling means.

2. A refrigerated food storage cabinet as claimed in Claim 1 in which the lower cooling means comprises a combination of vertical plates and panels of finned tubes in banks of serpentine form fed by refrigerant, the vertical plates being spaced away from the finned tubes, the said combination being situated parallel to the walls of the food storage chamber all round and having a gap between the bottom edges of the said combination and the base of the food storage chamber such that the said finned tubes lie between the plates and the walls of the food storage chamber so as to provide vertical channels between the said plates and the walls all round the lower periphery of the said food storage chamber and to provide a gap between the base of the food storage chamber and the bottom edges of the said plates and finned tubes.

3. A refrigerated food storage cabinet as claimed in claim 1 in which the upper cooling means comprises at least two module or unitary structures formed as a serpentine run of finned tubing in banks along their lengths through which refrigerant is circulated and having means for connecting and disconnecting the refrigerant circulation piping each to the other and to the upper cooling means refrigerant circulation system, and wherein the fins tranverse to the banks of tubing are in vertical section of an inverted tapering form, as for example, inverted isosceles triangular or inverted symmetrical trapezium shape, with straight or curved edges.

4. A refrigerated food storage cabinet as claimed in Claims 4 and 5 in which the units of the upper cooling means are demountable and detachable.

5. A refrigerated food storage cabinet as claimed in Claims 4, 5 and 6 in which the upper cooling means is adjustable in height relative to the lower cooling means.

6. A refrigerated food storage cabinet substantially as herein described with reference to and as illustrated by the accompanying drawings.

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1394342 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale

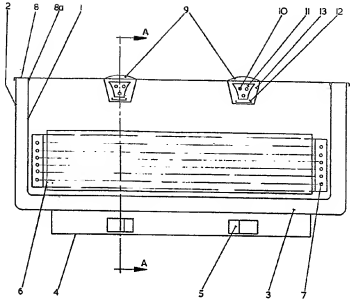

FIG.1